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Patentanmeldung Nr. Patent application No. Demande de brevet n°

02100759.6

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

R C van Dijk



Anmeldung Nr:
Application no.: 02100759.6
Demande no:

Anmeldetag:
Date of filing: 28.06.02
Date de dépôt:

Anmelder/Applicant(s)/Demandeur(s):

AGFA-GEVAERT
Septestraat 27
2640 Mortsel
BELGIQUE

Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
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Method for cleaning a nozzle plate

In Anspruch genommene Priorität(en) / Priority(ies) claimed /Priorité(s)
revendiquée(s)
Staat/Tag/Aktenzeichen/State/Date/File no./Pays/Date/Numéro de dépôt:

Internationale Patentklassifikation/International Patent Classification/
Classification internationale des brevets:

B41J2/00

Am Anmeldetag benannte Vertragstaaten/Contracting states designated at date of
filing/Etats contractants désignées lors du dépôt:

AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR

- 1 -

[ABSTRACT]

METHOD FOR CLEANING A NOZZLE PLATE

- 5 A method for cleaning a printhead wherein
- a solvent is applied followed by wet brushing of the nozzle plate to loosen debris collected on the nozzle plate.
 - A cleaning solvent is applied which is removed by vacuum cleaning in order clean the plate. A movement of the cleaning solvent over
- 10 the nozzle plate is provided.

Both steps can be combined using the brush between the application of a single cleaning solvent and the vacuum cleaning. The movement of solvent helps to clean the brush.

Different steps can be executed by a translating cleaning module.

15

Fig. 3

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[DESCRIPTION]

FIELD OF THE INVENTION

5 The present invention relates to inkjet printing mechanisms, such as printers or plotters.

More particularly the present invention relates to a mechanism for cleaning a printhead.

10 BACKGROUND OF THE INVENTION

Nowadays inkjet printing systems are used in a wide array of apparatuses and in a wide array of applications such as fax, colour photo printing, industrial applications etc. In these printing systems inks, possibly of various colours, is ejected out of at
15 least one array of nozzles located in a printhead to the receiving material.

A long known problem in inkjet printers is that the nozzles through which the ink is projected to the receiving material are blocked by clogging of ink inside the nozzles and on the printhead. This
20 renders certain nozzles inoperable and results in a defective print or deteriorated print quality.

To improve the clarity and contrast of the printed image, recent research has been focused to improvement of the used inks. To provide quicker, more waterfast printing with darker blacks and more
25 vivid colours, pigment based inks have been developed. These pigment-based inks have a higher solid content than the earlier dye-based inks. Both types of ink dry quickly, which allows inkjet printing mechanisms to form high quality images.

In some industrial applications, such as making of printing plates
30 using ink-jet processes, inks having special characteristics causing specific problems. E.g. UV curable inks exist to allow rapid hardening of inks by UV radiation after printing.

The combination of small nozzles and quick drying ink leaves the printheads susceptible to clogging, not only from dried ink and
35 minute dust particles or paper fibres, but also from the solids within the new ink themselves.

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It is known to counteract or correct the problem of clogging by protecting and cleaning the printhead by various methods.

- Capping : during non-operational periods the printhead can be sealed off from contaminants by a sealing enclosure. This also prevents the drying of the ink. The capping unit usually consists of a rubber seal placed around the nozzle array.
- Spitting : by periodically firing a number of drops of ink through each nozzle into a waste ink receiver, commonly called a spittoon, clogs are cleared from the nozzles. This can be concentrated to nozzles which are not used for a certain time but usually all the nozzles are actuated during spitting.
- Vacuum assisted purging : During a special operation, in order to clear partially or fully blocked nozzles, a printing cycle is actuated while on the outside of the nozzles a vacuum is applied. This helps clearing and cleansing of the nozzles. The purging is normally performed when the printhead is in the capping unit because this unit can provide a good seal around the nozzle array for building the vacuum.
- Application of solvents : By applying solvent ink residue is dissolved and the printhead can be cleaned, e.g. EP-A-1 018 430.
- Wiping : Before an during printing the inkjet printhead is wiped clean by using an elastomeric wiper, removing ink residue, paper dust and other impurities.
- Different combinations are known to clean the inkjet printheads.

In US 6 241 337 wiping is performed combined with vibrations and application and removal of a solvent. This method is due to the contact by the wiping action and the vibrations especially abrasive for the nozzle plate.

In US 5 557 306 ink is released from the nozzle plate, the plate is brushed and wiped afterwards. Due to the wiping action wear and tear of the nozzle plate is considerable.

The system describe in US 6 164 754 uses only longitudinal cleaning with a elastic pillar like member for cleaning the printhead having an indented groove with a nozzle section eventually combined with a elastic. This gives an unsatisfactory result and may also result in damage to the printhead.

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These features designed to clean and to protect a printhead , are commonly concentrated in a service station which is mounted within the plotter chassis, whereby the printhead can be moved over the station for maintenance. An example of such a service station can
5 be found in US-A-6 193 353 combining wiping, capping, spitting and purging functions.

As explained above cleaning actions, such as wiping, which make contact with the head cause considerable wear and tear upon the
10 nozzle plate. Special coatings present on the nozzle plate, in order to make the plate ink-repellent, tend to be damaged and therefor the printheads need to be replaced often. This is a cause of considerable cost.

Another problem is that certain prior art cleaning methods are not
15 well suited for every type of ink.

There is a need to provide cleaning methods for nozzle plates causing less wear and tear while cleaning needs to be sufficient. Hitherto no satisfactory cleaning methods have been provided.

20 SUMMARY OF THE INVENTION

The above-mentioned advantageous effects are realised by a method having the specific features set out in claim 1. A method for conditioning a printhead is given in claim 8.

25 An inkjet printing apparatus for using the method is given in claim 9. Specific features for preferred embodiments of the invention are set out in the dependent claims.

Further advantages and embodiments of the present invention will become apparent from the following description and drawings.

30

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows an example of an embodiment according to the present invention.

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Fig. 2 shows an embodiment according to the present invention wherein the solvent application and the cleaning solvent application are the same step.

Fig. 3 shows a cleaning module for executing the steps according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

A sufficient and non-abrasive cleaning method is provided by steps providing a combination of wet brushing and cleaning wherein a movement of solvent is provided over the nozzle plate.

First a solvent is applied on the nozzle plate

Another step is provided for loosening debris collected on the nozzle plate by brushing the nozzle plate with a brush in presence of the solvent.

Two steps provide cleaning of the nozzle plate with a solvent :

- In a separate step or a step combined with the first above a cleaning solvent is applied.
- Finally the nozzle plate is vacuum cleaned.

The brushing step in presence of a liquid or solvent has the advantage that wet brushing is less abrasive than dry brushing and that the brushing step is very effective in loosening debris collected on the nozzle plate.

The steps of applying a cleaning solvent and subsequent vacuum cleaning cause a movement of solvent over the nozzle plate which is very effective in removing debris and ink residue from the nozzle plate and clearing the nozzles.

Several examples of an embodiment according to the present invention will be given hereafter.

EXAMPLE 1

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In the following example wet brushing and solvent cleaning is provided in four different steps.

Reference is made to Fig. 1 wherein a nozzle plate 1 including nozzles 2 is depicted.

5 The different steps of the method are performed by separate means 3,4,5 which move over the nozzle plate 1 in the direction indicated by the arrow D. The different steps performed by the separate means therefor are performed consecutively and continuously at different location.

10 In a first step a solvent is applied to the nozzle plate 1. In this embodiment the ink itself is used as a solvent. The ink is a water based ink which can be easily used as a solvent due to lower drying speeds. The application is performed by bleeding ink from the nozzles 2 by jetting ink with very low power so that it remains on
15 the nozzle plate 1. It is also possible to use a special solvent applied by a special application means, e.g. an non image-wise jetting system.

The second step is performed by moving a brush 3 over the nozzle plate 1. The brush 3 contacting the nozzle plate 1 consists a woven
20 fabric of polytetrafluoroethylene (PTFE), commonly known as TEFLON®. Other types of brush 3 could be used.

The wet brushing step ensures an abrasive-free loosening of ink residue and other debris collected on the nozzle plate 1

After wet brushing a cleaning solvent is applied by e.g. a jetting
25 means 4. The solvent could also be applied using a contact system but preferably a non-contact system is used.

Directly after the application of the cleaning solvent on the nozzle plate 1 it is removed by vacuum cleaning by a vacuum cleaning means 5. Due to the constant application of the cleaning solvent
30 and the vacuum cleaning a movement of the solvent is created on the nozzle plate 1 over the nozzles 2 in a direction opposite to the movement of direction D.

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By the side-ways movement of the solvent provides also a mechanical effect of the cleaning solvent dragging loose particles along. Another fact is that due to the movement dissolving of ink residues is improved. This can be contributed to the same effect causing that
5 a solid is faster dissolved when the solvent and solid are stirred.

EXAMPLE 2

It is possible that the step of applying a solvent in order to enable wet brushing can be combined with the step of applying a
10 cleaning solvent. This results in the configuration of Fig. 2. In a first step a solvent is applied to the nozzle plate 1 by a jetting means 4 or any other appropriate system. The solvent will serves two purposes, i.e. solvent for enabling wet brushing and it will serve as a cleaning solvent.
15 This way no ink is wasted to enable wet brushing and no two separate solvent applications have to be done. Directly after application the nozzle plate 1 is brushed using a brush 3. A non-woven felt was used contacting the printhead. Likewise as in the above example the last step is a vacuum cleaning
20 step and likewise a movement of solvent is generated between the jetting means 4 and the vacuum cleaning means 5. The brush 3 will not obstruct the solvent flow if a system is provided using a brush 3 having a certain permeability. This system has a supplementary advantage that the brush 3 itself is
25 also cleaned or rinsed by the flow of solvent trough it. The system provided a good cleaning with less apparent wear to the nozzle plate 1.

EXAMPLE 3

30 Fig. 3 shows a cleaning module 6 for executing the method according to the present invention. The module 6 traverses over the printhead in the direction D indicated by the arrow. Module 6 comprises a slit or nozzle array 4 for applying solvent to the inkjet printhead. The applied volume is in between 5 to 200 ml /min and in fed through
35 inlet 7.

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In the centre the brush 3 for brushing the printhead is provided. At the other side a slit 5 is connected to a vacuum source via a vacuum connection 8. The pressure can be between -0,1 and -1 bar. The opening of the slits 4 and 5 are 0.5mm wide.

5 The module 6 traverses over the printhead at a speed between 0.001 and 0.05m/sec.

Further possible embodiments and alternatives are described below.

10 The constitution of the brush 3 may vary, any appropriate woven fabric e.g. velvet or non-woven e.g. felt brush 3 can be used. When the steps of applying a solvent and applying a cleaning solvent are combined, a certain porosity of the brush 3 has to be present to allow the movement of solvent over the nozzle plate 1.

15 The chemical composition of the brush 3 can be adapted to the composition of the ink and/or the nozzle plate 1. Possible materials which can be used and have proven effectiveness are e.g. polytetrafluoroethylene (PTFE) and polypropylene. Other materials are possible. The following list is not to be
20 considered limitative :PTFE, PP, PET, PUR, Nylon...

The brush 3 may be mounted fixed but, especially when using very viscous inks, it may be more efficient to provide an automatic mechanism to renew the brush 3.

One such possible mechanism is a system comprising a brush 3 in the
25 form of a fabric ribbon. The apparatus then comprises

- pay-out roll for feeding fresh brush fabric to the cleaning module,
- a brush surface for supporting the section of the ribbon in use as active brush 3,
- 30 - take-in roll for enrolling used brush fabric.

This provides easy renewal of the brush 3 when needed.

Direction and speed of cleaning

The most preferable cleaning system sweep the printhead in a longitudinal direction, however, depending on the size of the head

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or internal printer arrangement transversal cleaning is also possible.

Cleaning speeds may vary between 0.001 and 0.05 m/s but are preferably between 0.005 and 0.01 m/s

5

Recycling of solvent

When solvent is removed by vacuum cleaning it can be collected as a waste product for later removal. However in a more preferable embodiment the solvent is recycled and reused after e.g. filtering or other purification methods. This reduces waste generation of the printer.

Jetting of cleaning solvent

In order to generate the flow or movement of solvent over the nozzle plate 1, the cleaning solvent is preferably jetted onto the nozzle plate 1 by the jetting means at an angle with the normal of the nozzle plate 1 between 0 and 80 degrees.

This provides a good in depth cleaning of the nozzles and enables the generation of the solvent flow over the nozzle plate 1.

Direction of the jet can be adapted to desired cleaning speed or jetted volumes.

An effective method of conditioning the printhead for further printing can be provided by the steps of:

- 25 - Vacuum assisted purging : during this step a vacuum is applied on the outside of the nozzle plate 1. This can be done by bringing the printhead in contact with a capping unit which is connected to a vacuum source. If necessary the nozzles 2 of the printhead are fired to help clearing of blocked nozzles 2.
- 30 - During a spitting step the printhead is driven to further clear the nozzles 2.
- A cleaning step according to the present invention is provided
- To preserve the printhead in a ready state the printhead is brought in contact with a capping unit to prevent further contamination and drying of ink in the nozzles 2.

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Especially the combination of the vacuum assisted purging step and the improved cleaning are essential to provide a good conditioning of the printhead. Spitting can be performed and capping is only necessary when printing is not started immediately.

5

Having described in detail preferred embodiments of the current invention, it will now be apparent to those skilled in the art that numerous modifications can be made therein without departing from the scope of the invention as defined in the appending claims.

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[CLAIMS]

1. Method for cleaning the nozzle plate (1) of an inkjet printhead comprising the steps of :
 - 5 - providing a solvent on said nozzle plate (1),
 - loosening debris collected on said nozzle plate (1) by brushing said nozzle plate (1) in presence of said solvent with a brush(3),
 - applying a cleaning solvent to said nozzle plate (1),
 - 10 - subsequently removing said cleaning solvent and debris from said nozzle plate (1) by vacuum cleaning,characterised in that the application of said cleaning solvent and said subsequent removal of said cleaning solvent provides a movement of solvent over the nozzle plate (1).
- 15 2. Method according to claim 1 wherein the solvent provided on the nozzle plate (1) by bleeding ink from the nozzles (3).
3. Method according to any of the preceding claims wherein the step of providing said solvent and the step of applying said cleaning solvent is the same.
- 20 4. Method according to any one of the preceding claims wherein said brush (3) is composed of polytetrafluoroethylene, Polypropylene, Polyurethane, or Nylon
5. Method according to any of the preceding claims wherein the cleaning of the nozzle plate (1) is performed by a cleaning
25 module (6) translating in a transversal direction.
6. Method according to any one of claims 1 to 4 wherein cleaning of the nozzle plate (1) is performed by a cleaning module (6) translating in a longitudinal direction.
7. Method according to claim 5 or 6 wherein the speed of the
30 cleaning module (6) is between 0.001 and 0.005 meter/sec.

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8. Method for conditioning a printhead in an inkjet printer comprising the steps of :
- vacuum assisted purging and,
 - cleaning the nozzle plate(1) according to a method of claim 1 to 7 .
9. Inkjet printer having a inkjet printhead with a nozzle plate (1) and a cleaning system for said nozzle plate comprising :
- means for providing a solvent on said nozzle plate (1),
 - brush (3) for loosening debris collected on the nozzle plate (1) by brushing in presence of a solvent,
 - means for applying a cleaning solvent to said nozzle plate (1),
 - vacuum cleaning means for removing said cleaning solvent and debris from said nozzle plate (1) and for providing a movement of solvent over the nozzle plate (1).
10. Inkjet printer according to claim 9 wherein the brush (3) is a brush fabric in a brush unit comprising a
- pay-out roll for feeding fresh brush fabric,
 - a brush surface for supporting the active brush (3),
 - take-in roll for enrolling used brush fabric.
11. Inkjet printer according to claim 9 or 10 further comprising recycling means for recycling the removed cleaning solvent.

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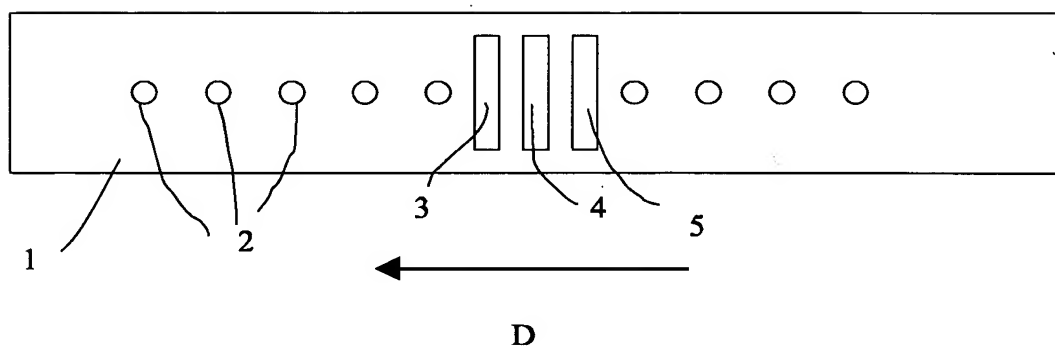


Fig. 1

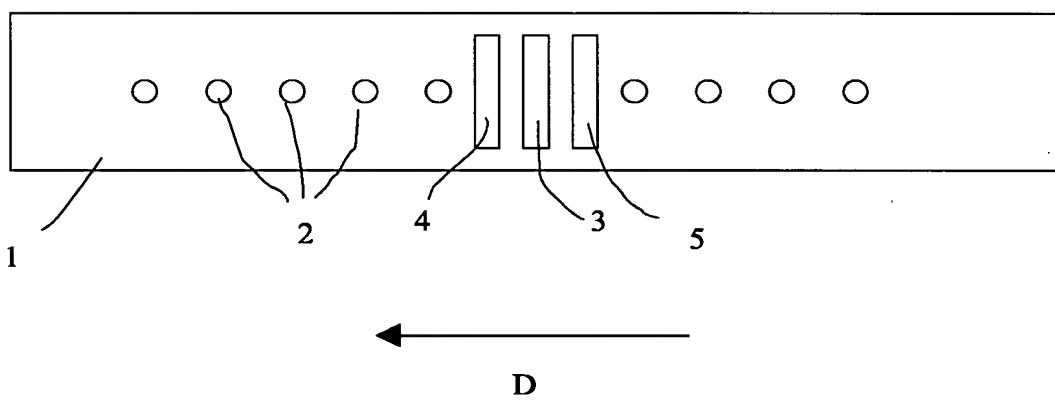


Fig. 2

